

Figure 1:

Amino acid sequences of Cpn60 and Cpn10:

SEQ ID No 1: Cpn10 (encoded by nucleotides pos. 458-751 of Figure 2):

MKIRPLHDRIVVRKKEETATAGGIILPGAAAEKPNQGVVISVGTGRILDNGSVQALA
VNEGDVVVFGKYSGQNTIDIDGEELLILNESDIYGVLEA

SEQ ID No 2: Cpn60 (encoded by nucleotides pos. 800-2446 of Figure 2):

MAAKDVLFGDSARAKMLVGVNILADAVRVTLGPKGRNVVIEKSFGAPIITKDGVSV
REIELKDKFENMGAQMVKEVASQANDQAGDGTATTATVLAQAIIEGLKSVAAGMNP
MDLKRIGDKATAAVVAAIKEQAQPCLDTKAIAQVGTISANADETVGRLIAEAMEKVG
KEGVITVEEGKGLEDELVDVEGMQFDRGYLSPYFINNQEKMTVEMENPLILLVDKKI
DNLQELLPILENVAKSGRPLLIVAEDVEGQALATLVVNNLRGTFKVA AVKAPGFGDR
RKAMLQDLAILTGGQVISEELGMSLETADPSSLGTASKVVIDKENTVIVDGAGTEASV
NTRVDQIRAEIESSTSDYDIEKLQERVAKLAGGVAVIKVGAGSEMEMKEKKDRVDDA
LHATRAAVEEGVVAGGGVALIRALSSVTTVGDNEDQNVGIALALRAMEAPIRQIAGN
AGAEGSVVVDKVKSGTGSFGFNASTGEYGDMIAMGILDPKAVTRSSLQAAASIAGL
MITTEAMVADAPVEEGAGGMPDMGGMGGMGMPGMM

Figure 2:

SEQ ID No 3: DNA coding for Cpn60 and Cpn10:

Cpn10, pos. 458-751

Cpn60, pos. 800-2446

atcaaaaaatgcagcaaggacagattcctgccaagaattagcagaaggttcttgtagcactggccggcgcttattattaacgccgg
gttttgtagcactgatgcgctgggttttacattactcgtccccgcgacgcgtaaacggttggtccataaggtgattgcatttattaccctc
gcatgatgactgcaagcagcttcaagcgacgggtagtttcaggaaggctcgtttaaagatgtacattcgacactgactcgcaaagca
gtcatgaaaaaatcacaattgaaggcgaatataccaagacgataagtaggtatttttcggctagccggtgaaatcctagtaaaagccc

cgataaattaaccatctatttttcacagaggcaatttagcctttgtttaccttattgatcctaatacttgggatccaacagttggagagtctagc
aaatgaaaatccgtccattacatgatcgtattgttgcgcgtaaaagaagaagagaccgcaactgcgggtggtatttttacc
ggcgctgcggcagaaaaaccaaatacaaggtgttattctctgtgggtactggcgtattcttgataatggttcagtgaagcgctggc
ggtaacgaaggcgatgttgcgttttggtaatactcaggtcaaaatactatcgatacgcgtgaagaattattgattttgaatga
aagtgatatctacggcggttttagaagcttaattattacactcacttttttatttaacctacaaaatttaaggaaagatcatggctgctaaagacg
tattatttggatagcgcacgcgcaaaaatgttggtaggtgtaaacattttagccgacgcagtaagagttaccttaggacctaa
aggtcgtaacgttgttatagaaaaatcatttggcgcacgcgatcatcaccaaagatggtgttctgttgcgcgtgaaatcgaattgaaagaca
aattcgaaaacatggcgccacagatggttaagggaagttgcttctcaagccaacgaccaagccggtgacggcacaacgacagcgactg
tactagcacaggcgattatcagcgaaggcttgaatctgttgcggctggcatgaatccaatggatcttaaacgtggtattgataaagctac
ggctgctgttgttgcgcgcaataaagaacaagctcagccttgcctggatacaaaagcaatcgctcaggtagggaacaatctctgccaatgc
cgatgaaacgggttggcgttttaattgctgaagcgatggaaaaagtcggtaaaagaaggtgtgattaccgttgaagaaggcaaaaggccttg
aagacgagcttgatgtttagaaggcatgcagttcgatcgcggttacttgtctccgtacttcatcaacaaccaagaaaaaatgaccgtag
aaatggaaaatccattaattctatttgggtgataagaaaattgataacctcaagagctgttggcaattcttgaaaacgtcgtctaaatcaggtc
gtccattattgatcgttgcgaagatgttgaaggccaagcactagcaacattggtagtaaaacaacttgcgcggcacattcaaggttgc
agcggtaaaagcccctgggttggcgcgcatcgtgtaaaagcgatgttgaagatcttgccatcttgacgggtggtcaggtatttctgaagag
ctagggatgtctttagaaactgcggatccttcttcttgggtacggcaagcagggtgttatcgataaagaaaacaccgtgattgttga
tggcgaggtactgaagcaagcgttaatactcgtgttgaccagatccgtgctgaaatcgaagctcgacttctgattacgacatcgaaaa
gtfacaagaacgcgttgctaagcttgcggcgccgttgcggtgattaaggttggcgggttctgaaatggaaatgaaagagaagaaa
gaccgtgttgacgatgcacttcatgcaactcgcgcagcgggtgaagaaggtgttgttgcgggtggtggtgttgccttgatcgcgcactct
cttcagtaaccgttgttgggtgataacgaagatcaaaacgtcggatttgacattggcacttctgctgatggaagctcctatccgtcaaatcgc
gggtaacgcaggtgctgaagggtcagtggttgttgataaagtgaatctggcacaggtagctttggttttaacgccagcacaggtgagt
atggcgatatgattgcgatgggtatttttagacctgcaaaagtcacgcgttcatctctacaagccgcggcgtctatcgaggtttgatgat
cacaaccgaagccatggttgcggatgcgcctgttgaagaaggcgtggtggtatgcctgatatggcgggcatgggtggaatggcggg
tatgcctggcatgatgtaatcatttgcattgtcctgatctgcttaccgtgtaaaaagatcaggctcaaggctgtctctataaaaagcc
gtatctttgatgagtgttgccttctgctgaaaacgacattctggagtgcggccttttttattttggtcataaaattcagaatattgtgtaatttta
tgtaactagctggcctataatgttgagttcctctgggtggcatgatctcatggtacttcaactaagcctgattcactgcg
gccttaacagtaaaaataaacgcaacgtagaacaataaagcgtatggcattaatgaagacggctgcatttaattcagatc

Figure 3:

SEQ ID No 4: Amino acid sequence of esterase cloned from *Oleispira antarctica* (EstRB8):

EstRB8 (encoded by nucleotides 1145 to 2143 Frame 2 of Figure 4) 333 aa

MKNTLKSSSRFSLKQLGTGALISSLFFGGCTTTQQDNLYTGVM SLARDSAGLEVKTA
SAGDVNLTYMERQGS DKDNAESVILLHGFSADKDNWILFTKEFDEKYHVI AVDLAG
HGDSEQLLT TDYGLIKQAERLDIFLSGLGVNSFHIAGNSMGG AISAIYSLSHPEKVKSL
TLIDAAGVDGDTESEYYKVL AEGKNPLIATDEASFEYRMGFTMTQPPFLPWPLRPSLL
RKT LARAEINN KIFSDMLKTKERLGMTNFQQKIEVKMAQHPLPTLIMWGKEDRVLD
VSAAA AFKKIIPQATVHIFPEVGHLPMVEIPSESAKVYEEFLSSIK

Figure 4:

SEQ ID No 5: DNA fragment from plasmid pBK1Est coding for esterase of *Oleispira antarctica* (EstRB8):

Nucleotide positions 1-100 correspond to reverse complement of positions 1196-1121 and 3799-3939 correspond to reverse complement of 1043-952 of pBK-CMV vector (Stratagene).

Positions 101-105 are *Bam*HI – *Sau*3A1 fusion and positions 3795-3798 are *Sau*3A1-*Bam*HI-fusion.

acaggaaacagctatgacctgattacgccaagctcgaaattaaccctcactaaaggaacaaaagctggagctcgcgcgcctgcag
gtcgacactagtggatcaacggcgttcattggtactggctgagctcagcgtcataatgccgatgcgatactggcgcgtcattgactgagctact
tctctgctagcaccgatttttctaatagcgcagcttcttttattctgaacgggcaactgatgtagtttttactaacggcgttttaggcatgg
taaactcttcgatattcaaaattattactgttcattacaatcatagctacaggctagaggcccaaaattgcagctgatattcacctttattatc
taagcattattacactcatcgcgggtgttattaattgtgctaaataaaaatacccgtagcggaaaaattcagcaaatagccaaagaaaacga
ttggcaataccaagaattcatcgattttgatgatgacattaagcaggcaaaccttggcctattaaactacagtcaaaatgcaatttttagacat
ctcattcaagcaactgacgaacactatggcttagcgtttaagacctttagctgtcgagcgttagaaccttcagggtattcacaatagcagcttt
atthttattaccctcgcatcaaaagactgaattcaataacctacacatttgccttaagtcgacatattcaagataaagatgccttcactgacatca
gtcaccaacaatcaatcaaacaccaataccaatcgcaaaaactcataaaactagccgatcaccaatcccaaaagcgttcaaaaatgaa
acgagcacgtcacacaaaatcaattatacgtacgaaccagggtcaaaactatcgttttttgagcacgtttgtccactaatgaaagaga
aaagtcgttaattcactggcgttttggcgtatccgcaccttcacatagaaattagtaattggcatgctactggcctttaaaaagaatcagtttaatt
gaagaaacctcgcttatctcagccattaccgctgtagccgaatttgcgcttatcctcagccatgattaaactgacgccaatfaataagac
atactaattaataactcccttaattgagaagaataatgaaaacacactcaaatcctcatcacgttttagctgaaacaactcggcaccggc
gctctgattatctccagtttgttctcgggtgtgcaccacaacacaagaataattatacacaggggttatgtctcttcgcgagagacagc
gctggcctagaagftaaaacagcctctgccggtgacgtcaatcttacttatatggaacgccaaaggcagtgacaaagataatgccgaaag

cgttattttattacacggtttctctgctgataaagataactggattctttttaccaaaagaattcgaatgaaaaatatcatgttatcgctgtcgattta
gcgggacatggcgattcagaacaattattaacgactgattacgggtctcataaaacaagccgagcgtttagatatcttcttctggcttagg
ggttaactcatttcacatcgccgtaattcaatggggggggctatcagcgaatctacagtttgagtcaccagagaaaagttaaaagtctt
acattgatcgatgcagcaggtgtcgatggcgatactgaaagcgaataactacaaagtttggcagaaggaagaatcctttaattgcaact
gatgaagcaagtttgaataccgcatgggtttccatgactcagcctcctttctaccttggccactaagaccttctttattacgtaaaacg
ctagcccgtgccgagatcaataacaaaatttttccgatatgctgaaaaccaaagaacgtttaggaatgactaactttcaacagaaaattg
aagtgaaaatggctcaacatccattgccaacactgattatgtggggcaaagaagatcgcggttcttgacgtatccgcagcagcggccttc
aaaaaataattccacaagcaactgttcataatcttctgaagtaggccacctacatggtagaaattcctagtgaagcgctaaagtattat
gaagagttttgtctctattfaaataagagcacataatcatgactgacttataaacagccaagcattfaaaatgcttggctgtttatttaattg
ccaaattattcaacgaccaagctctgcggtaaaatcgcatgtgggttcttgttttcatcaacagcaacaaacgtgaataccccgtaatcg
cattttctgattatcaaaatacatactttccaccagcatattaacttcaactttfaaactcgtccgccctacctctataacactggcagtcgaatt
cgacaatggtacctgcgggaacaggatgcttaaaatcgattcgatcactgctgacggttacgatgctttgtcgagaaaaacgagtcgct
gcaataaaagaaacctcatccactgcattgcagtgccaccgaataacglatcatgatgatttgtgtctctggaaataccgctttaga
aatagtggttttgatacgcgcttctgctgcgaataatatcttctctgctaagagttgcggatggcatacataaaactcgcttgattaagatta
ataataaatagttaacagtataattgaactgagggctgaagaactctaataacctctgaagaactttgagggcgctagagagaaaagacca
gtgataatatttcatcttgccatgagagcttatcatgaagcctgtgcttaaaatcaatcattatatttattcatctttaattgaaataataccaat
atatttcatatataatttcacactaccttatctcactagacttcccgcgataggcgcaacaataacgcaagttcacaataaagcgggttc
gctgcaacacatgccctagcgtctaaagtagcacgcacaacactggccagtcgtactagcccccttgcgattcgtgcagacgagcaac
aagcgctattaaacttacctaaatttctaaccaccaccattgggtctttccacaaaactcaaaaaactcgtaaatccgcttgcaatttaaacg
cgatgacatagatctaatecgattatcaaaccgcattcaagcgtcattaaaaacgcaccactggcaagaagttctacctgcactgacca
atatgcaagcggcgggcggaagagctgcctttgatcatgaagaagaggagcagcaaaagaggaaaacaatcaaaaagaggagag
caatcaataaaaaacgagttattgaggattttaattttaaaacaggtatattaataacctctctcgtagtaacaatgactgtatttacaaaa
ataaatagaggtataccatgtcaaacatctggttgaagtaccaaagattgaagtattaaaccgtcaaatggaaaatactgcctgcagcaa
cttaggcattcaaattacagaaattggcgatgattatatactggcacaatgccagcagatgcacgtaccttcagccaatgggactgatt
catggcggctcaaatgtattgtctggcagaaacactgggcagcatggcagctaactgctgtatttaattgtctcaagaatattgtgttggcc
aagaaattaacgccaaccacatacgcggtgttctccggcatagtactggcacagcaacgctagtacacaaaggaagaacctccca
gatttgggaaattcgcatcgttaacgatccaaagaattcaaaaagcttctcgagagtacttctagagcgggccgcccgcatttcc
accgggtggggtaccaggttaagtgtacccaattcgcctatagtgagtcgtattacaattcactggccgtcgttttac

Figure 5:

Amino acid sequences expressed from vector pBK1CpnEst: - the co-expression of fragments encoding native chaperonines with the esterase gene (EstRB8), all from *Oleispira antarctica*

SEQ ID No 6: cpn10 (nucleotides 113 to 403: Frame 2 of Figure 6) 97 aa:

MKIRPLHDRVRRKEEETATAGGILPGAAAEKPNQGVVISVGTGRILDNGSVQALA
VNEG DVVVF GKYS GQNTIDIDGEELLILNESDIYGVLEA

SEQ ID No 7: cpn60 (nucleotides 455 to 2098: Frame 2 of Figure 6) 548 aa:

MAAKDVLFGDSARAKMLVGVN ILADAVRVT LGPKGRNVVIEKSFGAPIITKDGVSV
REIELKDKFENMGAQM VKEVASQANDQAGDGT TTTATVLAQAIISEGLKSVAAGMNP
MDLKR GIDKATAAVVAAIKEQAQPCLDTKAIAQVGTISANA DETVGR LIAEAMEKVG
KEGVITVEEGKGLEDEL DVVEGMQFDRGYLSPYFINNQE KMTVEMENPLILLVDKKI
DNLQELLPILENVAKSGRPLLIVAEDVEGQALATLVVNNLRGTFKVA AVKAPGFGDR
RKAMLQDLAILTGGQVISEELGMSLETADPSSLGTASKVVIDKENTVIVDGAGTEASV
NTRVDQIRAEIESSTSDYDIEKLQERVAKLAGGVAVIKVGAGSEMEMKEKKDRVDDA
LHATRAAVEEGVVAGGGVALIRALSSVTTVVGDNEDQNVGIALALRAMEAPIRQIAGN
AGAEGSVVVDKVKSGTGSFGFNASTGEYGDMIAMGILDPK VTRSSLQAAASIAGL
MITTEAMVADAPVEEGAGGMPDMGGMGGMGGMGMPGMM

SEQ ID No 8: estRB8 (nucleotides 2579 to 3577: Frame 2 of Figure 6) 333 aa:

MKNTLKSSSRFSLKQLGTGALISSLFFGGCTTTQQDNLYTGVM SLARDSAGLEVKTA
SAGDVNLTYMERQGS DKDNAESVILLHGFSADKDNWILFTKEFDEKYHVIAVDLAG
HGDSEQLLT TDYGLIKQAERLDIFLSGLGVNSFHIAGNSMGG AISAIYSLSHPEKVKSL
TLIDAAGVDG DTESEYYKVLAEGKNPLIATDEASFEYRMGFTMTQPPFLPWPLRPSLL
RKTLARAEINN KIFSDMLKTKERLGMTNFQQKIEVKMAQHPLPTLIMWGKEDRVLD
VSAAA AFKKIIPQATVHIFPEVGH LPMVEIPSESAKVYEEFLSSIK

Figure 6:

SEQ ID No 9: pBK1CpnEst: - the fusion of native chaperonine-coding fragments with
esterase of *Oleispira antarctica* (EstRB8)

The DNA fragment coding for Cpn10 and Cpn60 is flanked by *SacI* site (pos. 69-75) and *SalI* site (encoded by pos. 2138-2143 of Figure 7):

Nucleotide positions 1-75 correspond to reverse complement of positions 1196-1121 and positions 5233-5273 correspond to reverse complement of 1043-952 of pBK-CMV vector (Stratagene)

Small letters – the Cpn10-Cpn60 encoding fragment,

Capital italics – fragments of vector pBK-CMV

Capital letters – fragment coding for EstRB8 from plasmid pBK1Est

ACAGGAAACAGCTATGACCTTGATTACGCCAAGCTCGAAATTAACCCTCACTAAAGGGA
*ACAAAAGCTGGAGCTC*cctaacttgggatccaacagttggagagtctagcaaatgaaaatccgtccattacatgatcgatt
gttcttcgccgtaaagaagaagagaccgcaactgcgggtggtatttttaccgggcgtgcggcagaaaaacaaatcaaggtgtgt
tatctctgtgggtactggccgtattcttgataatggtcagtgcaagcgtggcggtaacgaaggcgatgtgtcgttttgtaaatactc
aggtcaaaatactatcgatcgatggtaagaattattgatttgaatgaaagtatatctacggcgttttagaagcttaattattacactca
ctttttatttaacctacaaaatttaaggaaagatcatggctgctaaagacgtattatttggatagcgcacgcgcaaaaatgttgtaggt
gtaaacatttttagccgacgcagtaagagttaccttaggacctaaaggtcgtaacgttggtatagaaaaatcatttggatgcaccgatcatcac
caaagatggtgtttctgttcgcgtgaaatcgaattgaagacaaatcgaaaacatgggcgcacagatggttaaggaggtgcttctca
agccaacgaccaagccggtgacggcacaacgacagcgactgtactagcacaggcgattatcagcgaaggcttgaatctgttgcgg
ctggcatgaatccaatggatcttaaacgtggtattgataaagctacggctgctgtgttgcggccattaaagaacaagctcagccttgcttg
gatacaaaagcaatcgctcaggtagggacaatctctgccaatgccgatgaaacggttggtcgtttaattgctgaagcgatggaaaaagt
cggtaaagaaggtgtgattaccgttgaagaaggcaaaggccttgaagacgagcttgatgtttagaaggcatgcagttcgatcgcggtt
actgtctccgtacttcatcaacaaccaagaaaaatgaccgtagaaatgaaaaatcattaattctattggtgataagaaaattgataac
cttcaagagctgttgccaattcttgaaaacgtcgttaaatcaggtcgtccattattgatcgttgctgaagatgttgaaggccaagcactagc
aacattggtagtaaacacttgcgcggcacattcaaggttcagcgggttaaagcccctgggttggcgatcgtcgtaaagcgatgttgca
agatcttgccatcttgacgggtggtcaggtatttctgaagagctagggatgtctttagaaactgcggatccttcttcttgggtacggcaag
caaggttggtatcgataaagaaaacaccgtgattgttgatggcgcaggtactgaagcaagcgttaatactcgtgttgaccagatccgtgct
gaaatcgaaagctcgacttctgattacgacatcgaaaagtfacaagaacgcgttgctaagcttgcgggcggcgttgccgtgattaagggt

gggtgcgggttctgaaatggaatgaaagagaagaaagaccgtgttgacgatgcacttcacgaactcgcgagcggttgaagaaggt
gttgttcgggtgggtgttgccttgattcgcgcactctcttcagtaaccgtgttggtgataacgaagatcaaacgctcggtattgcattg
gcacttcgtgcgatggaagctcctatccgtcaaatcgcggtaacgcaggtgctgaagggtcagtggtgttgataaagtgaatctgg
cacaggtagctttgggttaacgccagcacaggtgagtatggcgatatgattgcgatgggtatttagaccctgcaaaagtcacgcgttca
tctctacaagccgcggcgctctatcgaggttgatgatcacaaccgaagccatgggtgcggatgcgcctgttgagaaggcgctgggtg
tatgcctgatatggcgccatgggtggaatggcggtatgcctggcatgatgaatcactttgtgattcattgtcctgatctgcttaccgtG
TCGACATATTCAAGATAAAGATGCCTTCACTGACATCAGTCACCAACAATCAATC
AAACACCAATACCAATCGCAAAAACCTCATAAACTAGCCGATCACCAAAATCCCA
AAAGCGTTCAAAAATGAAACGAGCACGTCACACAAAATCAATTTATACGCTAAC
GAACCAGGTCAAACCTTATCGTTTTTTTGAGCACGTTTGTTCCTACTAATGAAAGAG
AAAAGTCGTTAATTCCTGCTTTTGGCGTATCCGCACCTTCACATAGAAATTAGT
AATGGCATGCTACTGGCCTTTAAAAAGAATCAGTTAATTGAAGAAACCTCGCTTA
TCTCAGCCATTACCGCTGTAGCCGAATTTGCGCTTATCCTCAGCCATGATTAACT
GACGCCAATTAATATAAGACATACTAATTAATAACTCCCTTAATTGAGAAGAATA
ATGAAAAACACACTCAAATCCTCATCACGTTTTAGTCTGAAACAACTCGGCACCG
GCGCTCTGATTATCTCCAGTTTGTCTTCGGTGGTTGCACCACAACACAACAGAT
AATTTATACACAGGGGTATGTCTCTTGCGAGAGACAGCGCTGGCCTAGAAGTTA
AAACAGCCTCTGCCGGTGACGTCAATCTTACTTATATGGAACGCCAAGGCAGTGA
CAAAGATAATGCCGAAAGCGTTATTTTATTACACGGTTTCTCTGCTGATAAAGAT
AACTGGATTCTTTTTACCAAAGAATTCGATGAAAAATATCATGTTATCGCTGTCGA
TTTAGCGGGACATGGCGATTGAGAACAATTATTAACGACTGATTACGGTCTCATA
AAACAAGCCGAGCGTTTAGATATCTTCTTATCTGGCTTAGGGGTAACTCATTTC
CATCGCCGGTAATTCAATGGGGGGGGCTATCAGCGCAATCTACAGTTTGAGTCAC
CCAGAGAAAGTTAAAAGTCTTACATTGATCGATGCAGCAGGTGTCGATGGCGATA
CTGAAAGCGAATACTACAAAGTTTTGGCAGAAGGTAAGAATCCTTTAATTGCAAC
TGATGAAGCAAGTTTTGAATACCGCATGGGTTTACCATGACTCAGCCTCCTTTCC
TACCTTGGCCACTAAGACCTTCTTTATTACGTAACGCTAGCCCGTGCCGAGATC
AATAACAAAATTTTTTCCGATATGCTGAAAACCAAAGAACGTTTAGGAATGACTA
ACTTTCAACAGAAAATTGAAGTGAAAATGGCTCAACATCCATTGCCAACACTGAT
TATGTGGGGCAAAGAAGATCGCGTTCTTGACGTATCCGCAGCAGCGGCCTTCAAA
AAAATAATTCCACAAGCAACTGTTTCATATTTTTCTGAAGTAGGCCACCTACCTAT
GGTAGAAATTCCTAGTGAAAGCGCTAAAGTTTATGAAGAGTTTTTGTCTCTATTA
AATAAGAGCACATAATCATGACTGACTTATAAACAGCCAAGCATTTAAAATGCTT
GGCTGTTTATTTAATGGCCAAATTATTCAACGACCAAGCTCTGCGGTAAAATCG

CAGTGGGTTTCTTGTTTTTCATCAACAGCAACAAACGTGAAATACCCCGTAATCGC
ATTTTTCTGATTATCAAAATACATACTTTCCACCAGCATATTAACCTTCAACTTTTA
AACTCGTCCGCCCTACCTCTATAACACTGGCAGTCAATTGACAATGGTACCTGC
GGGAACAGGATGCTTAAAATCGATTGATCACTGCTGACGGTTACGATGCTTTGT
CGAGAAAAACGAGTCGCTGCAATAAAAGAAACCTCATCCATCCACTGCATTGCA
GTGCCACCGAATAACGTATCATGATGATTTGTTGTCTCTGGAAATACCGCTTTAGA
AATAGTGGTTTTTGATACGCGCTTTCGCTGCGCAATAATATCTTCTCTGCTAAGAG
TTGCGGATGGCATAACATAAACTCGCTTGATTAAGATTAATAATAAATAGTTAACA
GTATATTGAACTGAGGGTCTGAAGAACTCTAATACCTCTGAAGAACTTTGAGGCC
GCTAGAGAGAAAAGACCAGTGATAATATTTTCATCTTGCCATGAGAGCTTATCATG
AAAGCCTGTGCTTAAAATCAATCATTATATTTATTCATCTTTAATTGAAATAATAC
CAATATATTTTCATATATAATTTACACTACCCTTATCTCACTAGACTTCCCGCGCA
TAGGCGCAAACAATCAACGCAAGTTCACAATAAAGCGGTTTCGCTGCAACACATG
CCCTAGCGTCTAAAGTAGCACGCACAACACTGGCCAGTCGTACTAGCCCCTTTGC
GATTCGTGCAGACGAGCAACAAGCGCTATTAAACTTACCTAAATTTCTAACCACC
ACCATTGGTTCCTTTTCCACAACTCAAAAACTCGTCAAATCCGCTTGCAATTTAA
ACGCGATGACATAGATCTAATCGATTATCAAACCCGCATTCAAGCGCTCATTAAA
AACGCACCACTGGCAAGAAGTTCTACCTGCACTGACCAATATGCAAGCGGCGGC
GGAAGAGCTGCCTTTGATCGATCAAGAAGAAGGGAGCAGCAAAGAGGAAAACA
ATCAAAAAGAGGAGAGCAATCAAATAAAAACGAGTTATTGAGGATTTTAATTTTA
AAACAGGTATATTAATACCCTCTCTCGTAGTAAACAATGACTGTATTTACACAAA
AATAAATAGAGGTATACCATGTCAAACATCTGGTTTGAAGTACCAAAGATTGAAG
TATTAAACCGTCAAATGGAAAATACTGCCTGCAGCAACTTAGGCATTCAAATTAC
AGAAATTGGCGATGATTATATCACTGGCACAATGCCAGCAGATGCACGTACCTTC
CAGCCAATGGGACTGATTCATGGCGGCTCAAATGTATTGCTGGCAGAAACACTGG
GCAGCATGGCAGCTAACTGCTGTATTAATTTGTCTCAAGAATATTGTGTTGGCCA
AGAAATTAACGCCAACACATACGCGGTGTTTCGTTCCGGCATAGTGACTGGCACA
GCAACGCTAGTACACAAAGGAAGAACCTCCCAGATTTGGGAAATTCGCATCGTTA
ACGATCCAAAGAATTCAAAAAGCTTCTCGAGAGTACTTCTAGAGCGGCCGCGGGCCCCA
TCGATTTTCCACCCGGGTGGGGTACCAGGTAAGTGTACCCAATTCGCCCTATAGTGAGT
CGTATTACAATTCCTGGCCGTCGTTTTAC

Figure 7:

Amino acid sequences expressed from vector pBK1CpnSREst: - the co-expression of the stabilized single ring mutant chaperonin with the esterase gene (EstRB8) from *Oleispira antarctica* (cpn10::stabilized single ring mutant

Glu461Ala/Ser463Ala/Val464AlaGlu460Ala/Ser462Ala/Val463Ala::est)

SEQ ID No 10: cpn10 (nucleotides 113 to 403: Frame 2 of Figure 8) 97 aa:

MKIRPLHDRVRRKEEETATAGGIILPGAAAEKPNQGVVISVGTGRILDNGSVQALA
VNEGDVVVFGKYSGQNTIDIDGEELLILNESDIYGVLEA

Below – ***Capital bold letters*** are the mutations introduced

SEQ ID No 11: stabilized single ring mutant of cpn60 (nucleotides 455 to 2098: Frame 2 of Figure 8) 548 aa:

MAAKDVLFGDSARAKMLVGVN~~IL~~ADAVRVTLGPKGRNVVIEKSFGAPIITKDGVSV
REIELKDKFENMGAQM~~V~~KEVASQANDQAGDGT~~T~~TATVLAQAIISEGLKSVAAGMNP
MDLKR~~G~~IDKATAAVVAAI~~KE~~QAQPCLDTKAIAQVGTISANADET~~V~~GR~~L~~IAEAMEKVG
KEGVITVEEGKGLEDEL~~D~~VVEGMQFDRGYLSPYFINNQE~~K~~MTVEMENPLILLVDK~~K~~I
DNLQELLPILENVAKSGRPLLIVAEDVEGQALATLVVNNLRGTFKVA~~A~~VKAPGFGDR
RKAMLQDLAILTGGQVISEELGMSLETADPSSLG~~T~~ASKVVIDKENTVIVDGAGTEASV
NTRVDQIRAEIESSTSDYDIEKLQERVAKLAGGVAVIKVGAGSEMEMKEKKDRVDDA
LHATRAAVEEGVVAGGGVALIRALSSVTTVVGDNEDQNVGIALALRAMEAPIRQIAGN
AGA~~A~~G~~A~~A~~A~~VVDKVKSGTGSFGFNASTGEYGDMIAMGILDPK~~V~~TRSSLQAAASIAGL
MITTEAMVADAPVEEGAGGMPDMGGMGGMGGMGMPGMM

SEQ ID No 12: EstRB8 (nucleotides 2579 to 3577: Frame 2 of Figure 8) 333 aa:

MKNTLKSSSRFSLKQLGTGALIISS~~L~~FFGGCTTTQQDNLYTGVM~~S~~LARDSAGLEVKTA
SAGDVNLTYMERQGS~~D~~KDNAESVILLHGFSADKDNWILFTKEFDEKYH~~V~~IAVDLAG
HGDSEQLLTDDYGLIKQAERLDIFLSGLGVNSFHIAGNSMGG~~A~~ISAIYSLSHPEKVKSL

TLIDAAGVDGDTSEYYKVLAEKGKPLIATDEASFEYRMGFTMTQPPFLPWPLRPSLL
RKTLARAEINNKFSDMLKTKERLGMTNFQQKIEVKMAQHPLPTLIMWGKEDRVLD
VSAAAFAFKIIPQATVHIFPEVGHLPMEIPSESAKVYEEFLSSIK

Figure 8:

SEQ ID No 13: DNA sequence of vector pBK1CpnSREst: the expression cassette for the co-expression of the stabilized single ring mutant chaperonin with the esterase gene (EstRB8) from *Oleispira antarctica* (cpn10::stabilized single ring mutant Glu461Ala/Ser463Ala/Val464AlaGlu460Ala/Ser462Ala/Val463Ala::est)

Nucleotide positions 1-75 correspond to reverse complement of positions 1196-1121 and positions 5233-5273 correspond to reverse complement of 1043-952 of pBK-CMV vector (Stratagene)

DNA fragment coding for Cpn10 and Cpn60 is flanked by *SacI* site (pos. 69-75) and *SalI* site (pos. 2138-2143).

In the DNA sequence:

Small letters – the Cpn10-Cpn60 coding fragment,

Capital italics – fragments of vector

Capital letters – fragment coding for EstRB8 from plasmid pBK1Est

Capital bold letters = introduced mutations

ACAGGAAACAGCTATGACCTTGATTACGCCAAGCTCGAAATTAACCCTCACTAAAGGGA
*ACAAAAGCTGGAGCTC*cctaacttgggatccaacagttggagagtctagcaaatgaaatccgtccattacatgatcgtatt
gtgttcgccgtaaagaagaagagaccgcaactgcgggtggtattttaccggcgctgcggcagaaaaacaaatcaaggtgtgt
tatctctgtgggtactggccgtattcttgataatggttcagtgaacgctggcggttaacgaaggcgatgtgtcgttttggtaaatactc
aggtaaaatactatcgataatgatggtgaagaattattgatttgaatgaaagtatatctacggcgttttagaagcttaattattacactca
ctttttatttaacctacaaaatttaaggaaagatcatggctgctaaagacgtattttggtgatagcgcacgcgcaaaaatgttgtaggt
gtaaacatttttagccgacgcagtaagagttaccttaggacctaaaggctgtaacgttgttatagaaaaatcatttggtgcaccgatcatcac
caaagatggtgtttctgttgcgcgtgaaatgaattgaaagacaaatcgaaaacatgggcgcacagatggttaaggaagttgcttctca
agccaacgaccaagccggtgacggcacaacgacagcgactgtactagcacaggcgattatcagcgaaggcttgaatctgttgcgg

ctggcatgaatccaatggatcttaaacgtggattgataaagctacggctgctgtgttgccgccattaaagaacaagctcagccttgcttg
gatacaaaagcaatcgctcaggtagggaacaatctctgccaatgccgatgaaacgggtggcgtttaattgctgaagcgatggaaaaagt
cggtaagaaggtgtgattaccgtgaagaaggcaaaggcctgaagacgagcttgatgtttagaaggcatgcagttcgatcgcggtt
actgtctccgtacttcatcaacaaccaagaaaaatgaccgtagaatggaaaatccattaattctattgggtgataagaaaattgataac
cttcaagagctgttgccaattcttgaacacgtcgctaaatcaggtcgccattattgatcgttgctgaagatgttgaaggccaagcactagc
aacattggtagtaaacacttgcgcggcacattcaaggttcagcgggttaaagccccctggtttggcgatcgctgtaaagegatgttgca
agatcttgccatcttgacgggtggtcaggttatttctgaagagctagggatgtctttagaaactgcggatccttcttcttgggtacggcaag
caaggttggtatcgataagaaaacaccgtgattgttgatggcgcaggtactgaagcaagcgtaataactcgttgaccagatccgtgct
gaaatcgaaagctcgacttctgattacgacatcgaaaagttacaagaacgcgttgctaagcttgcgggcccgttgccgtgattaaggtt
gggtgcgggttctgaaatggaaatgaaagagaagaagaccgtgttgacgatgcacttcatgcaactcgcgcagcgggtgaagaaggt
gttgttcgggtgggtgttgccttgattcgcgcactctcttcagtaaccgtgttggtgataacgaagatcaaacgcggattgcatg
gcacttcgtgcgatggaagctcctatccgtcaaatcgcgggtaacgcaggtgctgCagggGcagCggtgttgataaagtgaatct
ggcacaggtagcttgggtttaacgccagcacaggtgagtatggcgatgatgctgatgggtattttagaccctgcaaaagtcacgcgtt
catctctacaagccgcggcgtctatcgcaggttgatgatcacaaccgaagccatggttgcggatgcgcctgttgaagaaggcgtggt
ggatgcctgatatggcgccatgggtggaatgggcgggtatgcctggcatgatgtaatcactttgtgattcattgtcctgatctgctaccg
tGTGACATATTCAAGATAAAGATGCCTTCACTGACATCAGTCACCAACAATCAAT
CAAACACCAATACCAATCGCAAAAACCTCATAAACTAGCCGATCACCAAATCCC
AAAAGCGTTCAAAAATGAAACGAGCACGTCACACAAAATCAATTTATACGCTAA
CGAACCAGGTCAAACCTTATCGTTTTTTTGAGCACGTTTGTTCCTAATGAAAGAG
AAAAGTCGTTAATTCCTGCTTTTGGCGTATCCGCACCTTCACATAGAAATTAGT
AATGGCATGCTACTGGCCTTTAAAAAGAATCAGTTAATTGAAGAAACCTCGCTTA
TCTCAGCCATTACCGCTGTAGCCGAATTTGCGCTTATCCTCAGCCATGATTAACT
GACGCCAATTAATATAAGACATACTAATTAATAACTCCCTTAATTGAGAAGAATA
ATGAAAAACACACTCAAATCCTCATCACGTTTTAGTCTGAAACAACTCGGCACCG
GCGCTCTGATTATCTCCAGTTTGTCTTCGGTGGTTGCACCACAACACAACAAGAT
AATTTATACACAGGGGTATGTCTCTTGCGAGAGACAGCGCTGGCCTAGAAGTTA
AAACAGCCTCTGCCGGTGACGTCAATCTTACTTATATGGAACGCCAAGGCAGTGA
CAAAGATAATGCCGAAAGCGTTATTTTATTACACGGTTTCTCTGCTGATAAAGAT
AACTGGATTCTTTTTACCAAAGAATTCGATGAAAAATATCATGTTATCGCTGTCGA
TTTAGCGGGACATGGCGATTGAGAACAATTATTAACGACTGATTACGGTCTCATA
AAACAAGCCGAGCGTTTAGATATCTTCTTATCTGGCTTAGGGGTAACTCATTCA
CATCGCCGTAATTCAATGGGGGGGGCTATCAGCGCAATCTACAGTTTGAGTCAC
CCAGAGAAAGTTAAAAGTCTTACATTGATCGATGCAGCAGGTGTCGATGGCGATA
CTGAAAGCGAATACTACAAAGTTTTTGGCAGAAGGTAAGAATCCTTTAATTGCAAC

TGATGAAGCAAGTTTTGAATACCGCATGGGTTTCACCATGACTCAGCCTCCTTTCC
TACCTTGGCCACTAAGACCTTCTTTATTACGTAAAACGCTAGCCCGTGCCGAGATC
AATAACAAAATTTTTCCGATATGCTGAAAACCAAAGAACGTTTAGGAATGACTA
ACTTTCAACAGAAAATTGAAGTGAAAATGGCTCAACATCCATTGCCAACACTGAT
TATGTGGGGCAAAGAAGATCGCGTTCTTGACGTATCCGCAGCAGCGGCCTTCAAA
AAAATAATTCCACAAGCAACTGTTTCATATTTTTCTGAAGTAGGCCACCTACCTAT
GGTAGAAATTCCTAGTGAAAGCGCTAAAGTTTATGAAGAGTTTTTGTCTCTATTA
AATAAGAGCACATAATCATGACTGACTTATAAACAGCCAAGCATTTAAAATGCTT
GGCTGTTTATTTAATGGCCAAATTATTCAACGACCAAGCTCTGCGGTAAAATCG
CAGTGGGTTTCTTGTTTTTCATCAACAGCAACAAACGTGAAATACCCCGTAATCGC
ATTTTTCTGATTATCAAAATACATACTTTCCACCAGCATATTAACCTTCAACTTTA
AACTCGTCCGCCCTACCTCTATAACACTGGCAGTCAATTCGACAATGGTACCTGC
GGGAACAGGATGCTTAAAATCGATTTCGATCACTGCTGACGGTTACGATGCTTTGT
CGAGAAAAACGAGTCGCTGCAATAAAAGAAACCTCATCCATCCACTGCATTGCA
GTGCCACCGAATAACGTATCATGATGATTGTTGTCTCTGGAAATACCGCTTTAGA
AATAGTGGTTTTTGATACGCGCTTTCGCTGCGCAATAATATCTTCTCTGCTAAGAG
TTGCGGATGGCATAACATAAACTCGCTTGATTAAGATTAATAATAAATAGTTAACA
GTATATTGAACTGAGGGTCTGAAGAACTCTAATACCTCTGAAGAACTTTGAGGCC
GCTAGAGAGAAAAGACCAGTGATAATATTTTCATCTTGCCATGAGAGCTTATCATG
AAAGCCTGTGCTTAAAATCAATCATTATATTTATTCATCTTTAATTGAAATAATAC
CAATATATTTTCATATATAATTTACACTACCCTTATCTCACTAGACTTCCCGCGCA
TAGGCGCAAACAATCAACGCAAGTTCACAATAAAGCGGTTCGCTGCAACACATG
CCCTAGCGTCTAAAGTAGCACGCACAACACTGGCCAGTCGTACTAGCCCCTTTGC
GATTCGTGCAGACGAGCAACAAGCGCTATTAAACTTACCTAAATTTCTAACCACC
ACCATTGGTTCTTTTCCACAACTCAAAAACTCGTCAAATCCGCTTGCAATTTAA
ACGCGATGACATAGATCTAATCGATTATCAAACCCGCATTCAAGCGCTCATTA
AACGCACCACTGGCAAGAAGTTCTACCTGCACTGACCAATATGCAAGCGGCGGC
GGAAGAGCTGCCTTTGATCGATCAAGAAGAAGGGAGCAGCAAAGAGGAAAACA
ATCAAAAAGAGGAGAGCAATCAAATAAAAACGAGTTATTGAGGATTTTAATTTTA
AAACAGGTATATTAATACCCTCTCTCGTAGTAAACAATGACTGTATTTACACAAA
AATAAATAGAGGTATACCATGTCAAACATCTGGTTTGAAGTACCAAAGATTGAAG
TATTAAACCGTCAAATGGAAAATACTGCCTGCAGCAACTTAGGCATTCAAATTAC
AGAAATTGGCGATGATTATATCACTGGCACAATGCCAGCAGATGCACGTACCTTC
CAGCCAATGGGACTGATTCATGGCGGCTCAAATGTATTGCTGGCAGAAACACTGG

GCAGCATGGCAGCTAACTGCTGTATTAATTTGTCTCAAGAATATTGTGTTGGCCA
AGAAATTAACGCCAACCACATACGCGGTGTTTCGTTCCGGCATAGTGACTGGCACA
GCAACGCTAGTACACAAAGGAAGAACCTCCCAGATTTGGGAAATTCGCATCGTTA
ACGATCCAAAGAATTCAAAAAGCTTCTCGAGAGTACTTCTAGAGCGGCCGCGGGCCCA
TCGATTTTCCACCCGGGTGGGGTACCAGGTAAGTGTACCCAATTCGCCCTATAGTGAGT
CGTATTACAATTCACTGGCCGTCGTTTTAC

Figure 9:

Amino acid sequence of the stabilized single ring mutant

Glu461Ala/Ser463Ala/Val464AlaGlu460Ala/Ser462Ala/Val463Ala of Cpn60:

SEQ ID No 14: Cpn10 (nucleotides 458-751 of Figure 10):

MKIRPLHDRVRRKEEETATAGGILPGAAAEKPNQGVVISVGTGRILDNGSVQALA
VNEG DVVVF GKYS GQNTIDIDGEELLILNESDIYGVLEA

SEQ ID No 15: Cpn60 (nucleotides 458-751 of Figure 10):

MAAKDVLFGDSARAKMLVGVN ILADAVRVT LGPKGRNVVIEKSFGAPIITKDGVSV
REIELKDKFENMGAQMVK EVASQANDQAGDGT TTVLAQAI ISEGLKSVAAGMNP
MDLKR GIDKATAAVVAAI KEQAQPCLDTKAIAQVGTISANA DETVGR LIAEAMEKVG
KEGVITVEEGKGLEDEL DVVEGMQFDRGYLSPYFINNQE KMTVEMENPLILLVDK KI
DNLQELLPILENVAKSGRPLLIVAEDVEGQALATLVVNNLRGTFKVA AVKAPGFGDR
RKAMLQDLAILTGGQVISEELGMSLETADPSSLGTASKVVIDKENTVIVDGAGTEASV
NTRVDQIRAEIESSTSDYDIEKLQERVAKLAGGVAVIKVGAGSEMEMKEKKDRVDDA
LHATRAAVEEGVVAGGGVALIRALSSVTTVVGDNEDQNVGIALALRAMEAPIRQIAGN
AGAAGAAVV DKKVSGTGSFGFNASTGEYGD MIAMGILDP AKVTRSSLQAAASIAGL
MITTEAMVADAPVEEGAGGMPDMGGMGGMGMPGMM

Figure 10:

SEQ ID No 16: DNA sequence of the stabilized single ring mutant

Glu461Ala/Ser463Ala/Val464AlaGlu460Ala/Ser462Ala/Val463Ala:

In the DNA sequence:

Small letters – the Cpn10-Cpn60 coding fragment,

Big bold letters = introduced mutations

atcaaaaaatgcagcaaggacagattcctgccaagaattagcagaaggttcttgtagcactggccggcgctttattattaacgccgg
gtttgtcactgatgcgctgggtttacattactcgtcccgcgacgcgtaaagcgttggtccataaggtgattgcatttattaccctc
gcatgatgactgcaagcagcttcaagcgacgggtagtttcaggaaggctcgtttaagatgtacattcgacactgactcgaaagca
gtcatgaaaaatcacaattgaaggcgaatataccaaagacgataagtaggtatttttcggctagccgttgaaatcctagtaaaagccc
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ggcgctgcggcagaaaaacaaatcaaggtgtgttatctctgtgggtactggccgtattcttgataatggttcagtgcgaagcgctggc
ggftaacgaaggcgatgtgtcgttttggtaatactcaggtcaaaatactatcgatatcgatggtgaagaattattgattttgaatga
aagtgatctacggcggttttagaagcttaattattacactcactttttatftaacctacaaaatftaaggaaagatcatggctgctaaagacg
tatttttggatagcgcacgcgcaaaaatgttggtaggtgtaaacattttagccgacgcagtaagagttaccttaggacctaa
aggtcgtaacgtgttatagaaaaatcatttgggtgcaccgatcatcaccaaagatggtgttctgttgcgcgtgaaatcgaattgaaagaca
aatcgaaaacatggggcgacagatggttaagggaagttgcttctcaagccaacgaccaagccggtgacggcacaacgacagcgactg
tactagcacaggcgattatcagcgaaggcttgaatctgttgcggctggcatgaatccaatggatcttaaacgtggtattgataaagctac
ggctgctgttgtgccccattaaagaacaagctcagccttcttgatacaaaagcaatcgctcaggtagggaacaatctctgccaatgc
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agcgggttaaagccctgggtttggcgatcgtcgtaaagcgatgttgcaagatcttgccatcttgacgggtggtcagggtatttctgaagag
ctagggatgtctttagaaactgcggatccttcttcttgggtacggcaagcaaggtgttatcgataaagaaaacaccgtgattgttga
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gttacaagaacgcgttgctaagcttgcggggcggttgcgtgattaaggttgggtgcgggttctgaaatggaaatgaaagagaagaaa
gaccgtgttgacgatgcacttcatgcaactcgcgcagcgggtgaagaaggtgtgttgcgggtggtggtgttgccttgattcgcgcactct
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agtatggcgatatgattgcgatgggtatttagaccctgcaaaagtcacgcgttcattctctacaagccggcgctctatcgcaggtttgat
gatcacaaccgaagccatggttgcggatgcgcctgttgaagaaggcgctgggtggtatgcctgatatggcgggcatgggtggaatggg
cggtatgcctggcatgatgtaatcactttgtgattcattgtcctgatctgcttaccgtgtaaaaagatcaggctcaaggctgtctctataaaa
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atttatgtaactagctggcctataatgttgagttcctctgggtggcatgatctcatggtacttcacttaagcctgattcactgcg
gctttaacagtaaaataataacgcaacgtagaaacataataagcgtatggcattaatgaagacggctgcatttaattcagatc